THE JOURNAL OF THE
CANADIAN ASSOCIATION OF RADIOLOGISTS

Volume 2 SEPTEMBER 1951 Number 3

THE MAXIMUM PERMISSABLE EXPOSURE TO RADIATION *

(Part II)

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The Allowable Exposure

There are two ways of formulating a recommended maximum allowable exposure. One is to determine an exposure which has been known over a long period to produce no adverse effects, add a safety factor if we wish, and adopt this as a safe exposure. This is probably the simplest way, and for some time was the only way available. Above all, it is a safe way, and those who adhere to such a code are usually overprotected by a certain margin. Where such a code is applicable, it should, of course be used. The disadvantages are that the safety factor is usually unknown, and the protective measures dictated by the code may often be excessively expensive.

The second method is to observe what dosages *do* produce ill effects, and if possible the threshold dosage for them. Theoretically the latter defines the maximum allowable exposure, and a known safety factor may be incorporated into the code. This method has the advantage of being more precise, and of affording a certain knowledge of the effects of exceeding the code. It ensures that excessive protective measures will not be employed, and, scientifically speaking, is more satisfactory. It has the disadvantage of being very difficult to determine - in fact only recently have some precise data appeared.

In the beginning, the first method was the only one possible. Now, the codes set up by it are being modified by application of the second method. Ultimately, the second method should logically prevail.

A — Experience

The damage which could be wrought by radiation on human beings became evident soon after the discovery of X-rays. The first symptoms were those of skin burns. When it was observed that a dosage rate corresponding to about 20 r per day did not produce burns, this was suggested as a "tolerance dose" by Rollins [11]. Mutscheller observed that radiation workers subjected to what corresponds to about 0.1 r per day averaged over a month did not suffer ill effects, and suggested this as a tolerance dose [12]. Barclay and Cox calculated the exposure to which an X-ray technician had been subjected over a six-year period. The technician had not suffered observable radiation damage, but Barclay and Cox introduced a safety factor of 25 anyway, and arrived at a figure corresponding to about 0.06 r per day [13]. Failla calculated that the technicians in his laboratory, who had not suffered any ill effects, had been subjected to an average of 0.02 r per day from radium gamma rays for periods up to four and a half years. He suggested this figure as a maximum allowable tolerance dose, it being readily adhered to in practice [14]. Basing their recommendations on a review of conditions in various places, the International X-Ray and Radium Commission [15], The American Advisory Committee on X-Ray and Radium Protection [16], The British X-Ray and Radium Protection Committee [17], and the League of Nations [18] have advised maximum allowable exposures ranging from 0.25 r to 0.1 r per day. The Canadian Government Atomic Energy Project keep their tolerance level down to 0.05 r per day [19]. These various recommendations are justified by such phrases as "... is apparently permissable..." [20], "...found to be safe at Memorial Hospital, N.Y..." [16], "...is considered safe..." [19], "...causes no detectable change in the blood count of workers..." [21], and "...appears to provide an adequate margin of safety..." [22].

The figure usually used as the tolerance dose for the past few years is, then, about 0.1 r per day. Note that this is an average, and that it might almost equally well be stated as 2.5 r per month. A period of a day however is convenient for measurement, and some would not permit the averaging to be made over more than 3 days [22]. The figures are based on normal operational procedure. Cantril and

* *Part I of this paper appeared in the June 1951 issue of the JCAR.*

Parker have reviewed the manner and intensity in which various people receive radiation, and they conclude that to follow the spirit of the recommended maximum allowable exposure, the permitted daily dose should not be absorbed in less than ten seconds [23]. For all practical purposes, this sets an upper limit of 10^{-2} r per second on the radiation field in which it is "possible" to maintain tolerable conditions, as long as you can get the day's work done in ten seconds.

These various recommendations have been made essentially by the first method, and in this sense may be considered as absolutely safe, and as incorporating an unknown safety factor. Their justification lies in the fact that, so far as their sponsors knew at the time, people subjected to this exposure for long periods show no ill effects.

B — Experimental

The second method of determining maximum allowable exposure is to measure observable effects of radiation on humans. At one end of the scale is the brutal fact that a whole-body dose of about 400 r absorbed within two weeks is usually lethal (this dose is about 300 times "tolerance"). In studying the just observable effects at the other end of the scale it is useful to classify them.

a) Effects on the Blood

Brauner and Gottlieb observed effects on the segmentation of leukocytes in man after a seven-minute whole body dose of 28 r [24]. This is about 7 times higher than tolerance rate, although about 300 times the daily allowable dose. A single 50 r dose produces measurable effects [22], but apparently produces no lasting harm if not repeated. Among radium dial painters, 1 microgram of radium deposited in the body has proven a fatal dose, anemia resulting from bombardment of the marrow [23]. This amounts to roughly 50,000 ergs per day delivered to the marrow, or about 0.2 rep per day assuming the radium is uniformly distributed. Although bone marrow has considerable recuperative powers for fairly high doses, this power is gradually lost if the radiation is prolonged indefinitely. Aplastic anemia has thus been attributed to a dosage of 1 r per day, continued over a period of years. Several such cases ultimately proved fatal [25]. More recently, Ingram and Barnes have reported the discovery of the development of lymphocytes with biloped nuclei from radiation fields *well below* tolerance levels [36].

In comparing these measured findings, it would appear that the maximum allowable exposure of 0.1 r per day is too high to preclude observable effects, and incorporates a safety factor of less than 10 for dangerous and even lethal effects.

b) Effects on the Lungs

Local irradiation of the lungs occurs when the air contains radioactive gases, vapors, or dust, such as radon, active iodine vapor, etc. Knowing the concentration of activity in the air, it is possible to estimate the dose received by the lungs by such methods as those of Failla [21] and Evans [22]. Observed effects include cancer of the lung, or more precisely, carcinoma of the bronchus. A concentration of 3×10^{-12} curie of radon per cc of air, which proved fatal in the long run to a number of miners [23], corresponds to a dose of roughly 0.15 rep per day to the bronchus. It would, of course, take a higher external field to produce this intensity at the lungs, but it is indicative of the intensity injurious to an organ, and the safety factor is not large.

c) Effects on the Skin

It is interesting to note that the dead corneus outer layer of the skin affords considerable protection against heavy-particle radiation, and even against weak beta-rays. Where the radiation can penetrate to the lower, living, layers, a burn-like reddening called erythema can result, with more serious damage following continued radiation. This formed the basis for some early tolerance considerations, and we know that 0.1 r per day is about 1 percent of a soft X-ray erythema dose. The skin can recuperate from this from day to day. It can tolerate in the same way, about 1 r per day on the hands, according to the experience of some radiologists. In general, the skin seems able to withstand radiation exposures considerably above tolerance. However large doses acquired through such habits as holding dental X-ray film in place with the fingers have been known to produce serious damage to the hand.

d) Effects on Fertility

Although it is known that permanent and complete sterility is caused by large doses to the ovaries (of the order of 400 r [23]) very little is known about the effects of repeated low doses, in the case of humans. In mice, it has been shown that a dosage rate of 2 r per day is sufficient to reduce fertility [27]. In rabbits, an accumulated dose of 100 r produced a marked decrease of spermatogonia and spermatocytes [28]. Guinea pigs have shown similar effects after total doses of 100 r given at the rate of 8 r per day [28]. In animals, then, the present maximum allowable exposure incorporates a safety factor of less than 10 for

observed effects on fertility. Experience in extrapolating other effects, measurable in humans, indicates that the factor here is probably similar.

e) Effects on Genetics

The characteristics of human beings are determined by the individual genes in the chromosomes. These genes may be dislocated or damaged by a single ionising event. Therefore a single photon or particle is sufficient to cause a mutation, and in the presence of cosmic radiation no one is immune. The probability of such an event is extremely small, but as the radiation field increases so does the probability. It has been estimated that the probability of there being produced a dominant mutation is increased by a factor of ten by an accumulated dose of 300 r in the female [29]. This corresponds to a ten-year dose at present maximum allowable exposure. However the overall effect on the population is quite negligible. Evans has calculated that the genetic effects on the population would be changed by less than 10 percent, should as many as 1 person in twenty be exposed continuously to the tolerance dose and the effects accumulated for a thousand years [30]. From this point of view the present level seems more than adequate.

f) Summary

The various effects of radiation mentioned are the main ones which take place at intensity levels approaching the maximum allowable. It is interesting to summarize them as follows:

Effect on	Safety Factor in present Tolerance for observable effect	Safety Factor in present Tolerance for dangerous effect
Blood	none [26]	less than 5 [25]
Lungs	—	less than 10 [23]
Skin	100 [12]	—
Fertility	less than 10 [27]	—
Genetics	none [29]	very high [30]

From this summary, we may conclude that the present maximum allowable exposure will cause observable effects on the persons irradiated, and contains in general a safety factor of less than ten and possibly less than 5 for dangerous effects. These figures are determined by the second method, i.e. by measurement of observed effects.

Conclusions

The maximum allowable exposure of 0.1 r per day, considered from experience as being harmless, has been shown by experiment to produce observable effects on humans, and to be within a factor of less than 5 of producing harmful effects in some cases. Some of this data has become available but very recently, and has caused some uneasiness. The main effect has been a strong tendency to lower the permissable exposure. In Canada, the figure established for some time has been 0.05 r per day. At the 6th International Congress of Radiology held in London in 1950, it was proposed to generalize this figure to a maximum permissable exposure of 0.3 r per week. The International Recommendations on Radiological Protection just issued contain this figure [31]. This is considered to make the safety factor more reasonable, and it is probable that this figure will eventually become universally accepted.

As the data become published however, and the effects of radiation are seen to be increasingly complex and insidious, it becomes more and more obvious that a single permissable exposure is too simple and unwieldy. In the first place, it would seem logical to distinguish between a dosage rate which protected from *observable* effects, and one which would prevent *harmful* effects. The former would ensure adequate safeguards for a population; the latter seems more reasonable for individuals. The increasing use of radiation might eventually make legislation necessary, where at present educated opinion is sufficient and flexible. And even now it appears that distinction between groups is necessary. A future definition of permissable exposure should probably distinguish as follows:

a) For the general public: 0.1 r per week. This would minimize genetic and other effects in the unlikely event of large sections of the population being constantly irradiated by future radioactive installations.

b) For professional people: 0.3 r per week. This, at the moment, seems to incorporate a safety factor of at least 10 for harmful effects. It would affect only a small fraction of the population exposed only part of the time.

c) For radiologists and physicists—higher doses depending on circumstances.

In the last case, the experts' knowledge is the determining factor. For instance, it seems that even 1 r per day to the hands only is not harmful, and a skilled radiologist could keep whole-body exposure within tolerable limits, yet perform necessary work with his hands.

For nurses, technicians, students, — all, in fact, except experts, an imposed and regulated maximum permissable exposure seems mandatory for complete safety. Even with their advanced knowledge, the experts are not always immune. March [32] has observed that 10 times as many radiologists die of leukemia than do other physicians. Binks [33] has recently commented on a number of accidents and illnesses occurring to professionals due to overexposure. The shiny finger-tips and nails of some X-Ray therapists are considered by some a badge of their profession.

It is not sufficient to define a safe maximum permissable exposure. Everyone working with radiation must know *why* it was defined, and how dangerous effects lurk less than a factor of five away.

CONCLUSION

Le maximum d'exposition permis d'un dixième d'r par jour, considéré expérimentalement comme inoffensif, produit en réalité des effets décelables sur le matériel humain et s'est montré à l'occasion, apte à donner lieu à des effets nocifs, dans les limites d'un facteur inférieur à 5. Des constatations de ce genre, ont été enrégistrées seulement récemment et ont produit une certaine inquiétude, laquelle s'est traduite par une forte tendance à abaisser l'exposition tolérable. Au Canada, la valeur admise depuis quelque temps a été de 0.05 r par jour. Au sixième congrès International de Radiologie, tenu à Londres en 1950, il a été proposé de fixer le maximum d'exposition hebdomadaire à 0.3 r. Les recommandations internationales pour la protection contre les radiations, publiées récemment, font mention de cette valeur [31]. Le facteur de sécurité est rendu ainsi plus accessible et il est probable que cette valeur sera acceptée partout.

A mesure que les résultats sont publiés, et que les effets des radiations apparaissent plus complexes et insidieux, il devient de plus en plus évident que l'exposition permise en une seule séance représente une donnée trop simple et trop peu maniable. En premier lieu, il semblerait logique de distinguer un régime d'exposition qui mettrait à l'abri d'effets *décelables*, d'un régime qui empêcherait l'apparition d'effets *nocifs*. Le premier pourrait servir de limite de sécurité pour une population, le dernier semblerait plus applicable aux individus. L'emploi de plus en plus répandu des radiations peut amener éventuellement la nécessité d'une législation, alors que pour le moment, une formule concertée est plus flexible et peut suffire. Mais même actuellement, il semble qu'une distinction entre les deux groupes s'impose.

Une définition future de l'exposition à autoriser devra probablement faire la distinction suivante:

a) Pour le public en général: 0.1 r par semaine. Ceci réduirait les effets génétiques et autres dans le cas improbable de grandes agglomérations soumises aux installations radioactives de l'avenir.

b) Pour le personnel de la profession: 0.3 r par semaine. Ceci semble fournir, pour le moment, un facteur de sécurité de 10 en ce qui aurait trait aux effets nocifs. Les gens visés ici représentent seulement une faible partie de la population, laquelle partie ne subirait qu'une exposition fractionnée.

c) Pour les radiologistes et les physiciens, on pourrait suivant les circonstances, tolérer des doses plus élevées.

Dans le dernier cas, les connaissances du spécialiste constituent un facteur déterminant. Par exemple il semble que même la dose de 1 r par jour, limitée aux mains, n'est pas dommageable et un radiologiste entraîné pourrait se livrer à ses occupations ordinaires, en se tenant dans les limites tolérables pour ce qui a trait à une irradiation généralisée.

Pour les infirmières, les techniciens, les étudiants, pour tout le monde, en fait, en dehors des spécialistes, un maximum d'exposition codifié et imposé parait recommandable pour une sécurité complète. Mais même avec leurs connaissances, les spécialistes ne sont pas à l'abri des dangers. March [32] a observé qu'il y a dix fois plus de radiologistes que d'autres médecins qui meurent de leucémie. Binks [33] a étudié récemment les accidents et les malaises qui surviennent chez les professionnels soumis à des expositions trop prolongées ou trop intenses. L'aspect luisant des extrémités digitales et des ongles chez certains radiothérapeutes est considéré par quelques auteurs comme une marque distinctive de leur profession.

Il ne suffit pas de fixer un maximum d'exposition de sécurité. Tous ceux qui travaillent dans les radiations doivent savoir pourquoi ce maximum a été fixé et combien d'effets nocifs peuvent se cacher derrière un facteur de sécurité qui dépasse 5.

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Erratum: In Part I of this paper, the numerical example involving irradiation by Ca^{45} gives a distributed dose of 1 rep, not 1000 rep.

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SOME PHYSIOLOGICAL ASPECTS OF INTESTINAL OBSTRUCTION *

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In the diagnosis of intestinal obstruction the x-ray is of fundamental importance.

This short review is an attempt to correlate the radiological findings with the pathological and physiological background. To this end the literature has been reviewed, and cases from the files of the Montreal General Hospital have been selected to illustrate the pertinent features.

At the onset it must be said that the radiological picture does not give the complete answer in any one case of intestinal obstruction. There must be a correlation with the clinical findings.

In making an approach to the diagnosis of intestinal obstruction there are certain pathological considerations which must be considered: —

Classifications:

(a) Mechanical - Dynamic - 1) Acute;
2) Chronic
(a) Complete;
(b) Partial.

(b) Inhibition - Adynamic - 1) Neurogenic:
2) Traumatic;
3) Infective;
4) Vascular;
5) Specific.

Etiology:

In a recent analysis of 100 cases of acute abdominal disease reported by Benjamin S. Brown [1] the commonest causes of each main type are listed as follows:

(a) Mechanical: 1) Adhesions as the result of previous surgery;
2) Carcinoma of the colon.

(b) Inhibition: (Paralytic or Adynamic ileus).
1) Local peritonitis;
2) General peritonitis.

Mechanical ileus causes stasis of the intestinal contents and causes the fluid and gas to accumulate.

Source of the Gas - is largely swallowed air. Wagenstein [2] has shown that 68% is swallowed air and that 32% forms within the body; of the latter, 22% is the result of diffusion from the blood stream and 10% the result of fermentation.

Under normal circumstances gas is visualized only in the stomach and colon of the normal adult abdomen, the sites where intestinal contents remain static. Under normal circumstances gas is present throughout the small bowel but not visualized due to the fact that it is broken up in minute amounts and held in a state of admixture with the fluid due to its rapid transit. Under the influence of stasis, either inhibition or mechanical, gas and fluid separate.

Approximately 7000 c.c.'s of fluid are poured into the gastro-intestinal tract daily, and under the influence of distention and obstruction, this is increased. The static fluid and gas are thrown into large pools hour by hour by the vigorous action of the hyperperistaltic bowel. Each obstructed loop falls on the one adjacent, giving the classical hair-pin kinks which are a feature of mechanical obstruction so commonly seen by the surgeon and radiologist. The bowel shortens 20-30% over a considerable length, becomes injected, the mucosal villi become oedematous and clubbed. The occurrence of thick oedematous walls is the result of inflammatory migration which exudate collecting between the loops.

In colon obstruction the degree of large bowel distention depends on the efficiency of the ileo-caecal valve. An incompetent ileo-caecal valve will cause small bowel distention in the presence of colonic obstruction.

The radiological pattern is a dynamic one revealing gas and fluid levels in the upright film. The small bowel is recognized by site and structure, central in location, jejunal loops in the upper and ileal loops in the lower central abdomen. [3] The sharp hair-pin kinks are noted, the distended valvulae conniventes standing out as a spring ready to uncoil. The early picture may show thin bowel walls, later thick radio-opaque bands may be seen between the loops indicative of oedema which collects mainly in the loose areolar sub mucosal layer. The occurrence of blurred areas means movement. If doubt exists a further scout film taken the same day may often show a radical change in the bowel pattern.

Inhibition ileus (adynamic or paralytic ileus) has a very different physiological background, the commonest cause being peritonitis, either local or general. Its occurrence in a mild grade following intra-abdominal operations of almost every sort is well known.

Many other causes acting through the sympathetic nervous system are known as in retro-peritoneal haemorrhage, vertebral fractures, renal colic and many other conditions. The stimulated sympathetic inhibits peristalsis either segmentally or generally causing stasis. Gas accumulates as before, fluid collects, all degrees of bowel distention being noted.

* Presented at the Mid-Winter Meeting Canadian Association of Radiologists, Niagara Falls, January 3, 4, 5, 1951.

A good example of segmental inhibition ileus may be seen in acute pancreatitis where a "sentinel loop" of dilated upper small bowel is often visualized. Grollman [4] and his associates reported eight cases of acute pancreatitis recently, each of which showed this single dilated upper small bowel segment. It has been noted associated with other local inflammatory conditions such as acute cholecystitis and acute appendicitis.

In generalized peritonitis the entire peritoneum is a thickened dull surface covered with inflammatory exudate which results in a generalized inhibitory state of the abdominal gastro-intestinal tract. Free fluid and gas may be present in the peritoneal cavity.

The radiological pattern in this adynamic type is quite different. There are no sharp hair-pin kinks, but fluid levels and gas in distended loops of both small and large bowel. The gas may be evenly distributed. There are no blurred areas noted. The picture is a quiet one which shows little or no change in further scout films. It has not been our practice to pay much attention to the pro-peritoneal fat line. There are occasions in which the differential diagnosis of mechanical and adynamic ileus is very difficult - sometimes impossible.

The history of nausea and vomiting with colicy pain together with the radiological picture of mechanical ileus, often makes the diagnosis quite accurate. Distention, frequently of high grade, without vomiting, but with colic frequently localizes the colon as a closed loop. The so-called sentinel loop of dilated small bowel in the upper abdomen may offer some help. This together with an elevated serum amylase may localize the pancreas as the seat of trouble.

CASES

CASE 1

O.F., a 37 year-old white male. admitted with the history of nausea and vomiting and generalized abdominal pain of 10 hours duration. Previous history revealed that a laparotomy was done three months previous to admission — reason was not given.

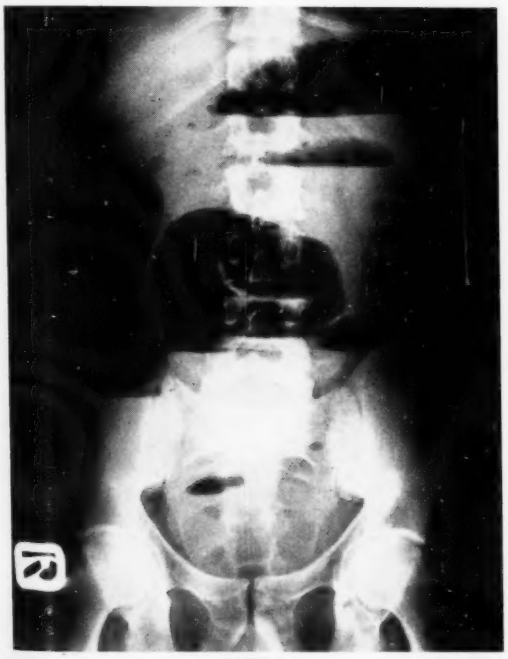
Physical Examination:

Physical examination revealed an acutely tender, distended splinted abdomen showing visible peristalsis.

Routine roentgenograms were taken, chest, upright and supine abdomen films. The chest was not remarkable. The films of the abdomen revealed classical hair-pin curves of dilated small bowel showing fluid levels and gas. The clinical and roentgenological diagnosis was: Mechanical Ileus of the Small Bowel, probably about mid-ileum.

Laparotomy revealed small bowel obstruction due to an adhesive band completely obstructing the ileum in its upper limits.

The patient made an uneventful recovery.



CASE I

CASE I

CASE II

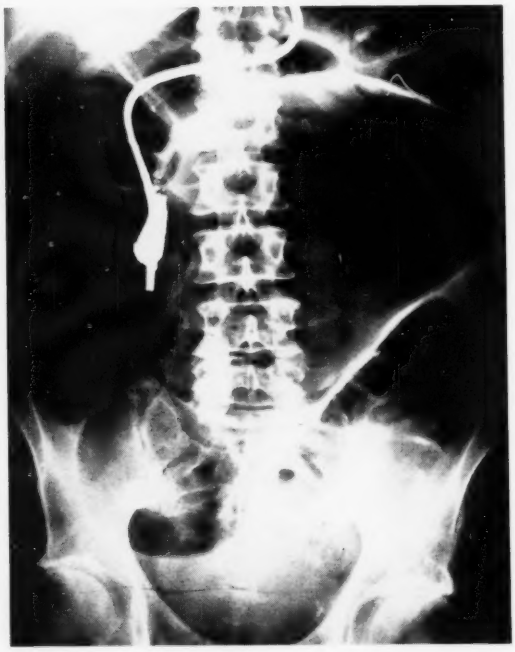
F.A., a 65 year-old white male admitted with the history of: —

1. Crampy abdominal pain of twelve hours duration, nausea, vomiting for twelve hours prior to admission.
2. Increasing constipation of recent origin.

The abdomen was markedly distended and generally tender. Roentgenograms revealed a large dislated loop of bowel arising from the pelvis and almost filling the abdomen. The ascending and transverse colon were less markedly dilated. A few dilated loops of small bowel were noted in the region of the ileum. The upright film showed that the large loop contained two fluid levels. The chest film was not remarkable.

The clinical and roentgenological diagnosis was: Mechanical Ileus of the Large Bowel, due to a volvulus of the sigmoid colon.

Laparotomy revealed an anti-clockwise torsion of 180° of the sigmoid colon.



CASE II

CASE II

CASE III

A.P., a 46 year-old white female admitted with the complaints of: —

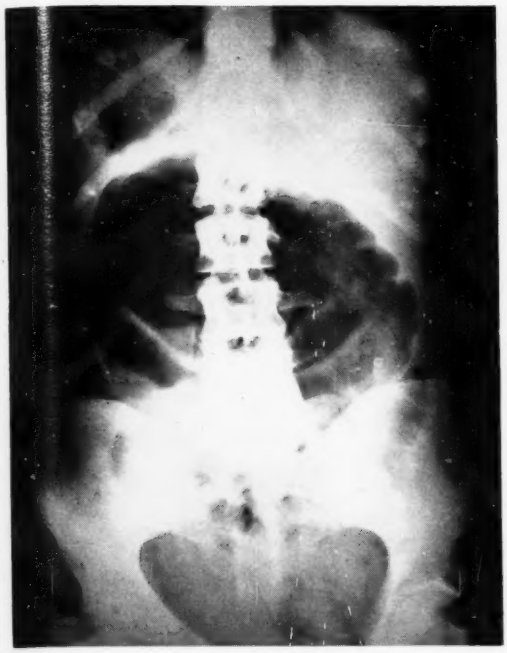
1. Nausea and vomiting for two days.
2. Crampy abdominal pain for two days.
3. Increasing constipation of recent origin.

Previous History:

Previous history: appendectomy some seven years prior to onset of present illness.

Examination was essentially negative except that the abdomen presented a palpable mass about the size of a large bowling ball noted in the umbilical area. It was acutely tender; the abdominal wall was not splinted.

The roentgenograms revealed a large centrally placed group of dilated loops of bowel showing both small and large bowel patterns. A barium enema was then given which revealed non visualization of the caecum and terminal ileum. A diagnosis was made of: Volvulus of the Caecum. This was confirmed at operation.



CASE III

CASE III

CASE IV

A.L., a 36 year-old male admitted with generalized abdominal pain of three days' duration, nausea and vomiting twelve hours prior to admission. The original pain was epigastric in nature, later radiating to the right lower quadrant. Twenty-four hours prior to admission, the pain was of a generalized character. Examination showed that the abdomen was distended, tender. Nothing unusual felt by rectal examination.

Roentgenograms revealed dilated loops of both small and large bowel, the gas equally distributed throughout the bowel. The upright film showed multiple segmental fluid levels. A diagnosis was made of: Inhibition Ileus. At operation an acute ulcerative appendicitis with localized peritonitis was found.

CASE IV

CASE IV

SUMMARY

1. The commonest causes of obstruction are as follows: —
   A. Mechanical obstruction:
      1. Adhesions as the result of previous surgery.
      2. Carcinoma of the colon.
   B. Inhibition obstruction:
      Peritonitis, local or general.
2. The source of the air, both in mechanical and inhibition types of obstruction is mainly swallowed air. This air is present throughout the gastro-intestinal tract. It is held in a state of admixture by the rapid transit of the fluid. In the presence of stasis the air and the fluid are both visualized in roentgenograms.
3. Mechanical ileus is rapidly changing radiological picture in contrast to the inhibition type and a further flat film may often be of great assistance in differential diagnosis.
4. The so-called "sentinel loop" of paralytic ileus is mentioned as another useful sign to assist in the differential diagnosis. An elevated serum amylase will often help in differentiating the pancreas as a possible source of infection.
5. The clinical picture must always be associated with the radiological findings. The cases shown demonstrate the pertinent features.

RESUME

1. Les causes d'obstruction les plus communes sont:
   (a) d'origine mécanique, attribuables
      (1) à des adhérences consécutives à des interventions antérieures, ou
      (2) à un cancer du côlon.
   (b) d'origine paralytique, dues à une péritonite locale ou généralisée.
2. L'air, dans les deux types, mécanique et paralytique, est en majeure partie, de l'air dégluti. Cet air se retrouve dans tout le tractus digestif. Il se mélange aux liquides par suite du transit rapide de ces derniers. En cas de stase, l'air et le liquide sont rendus visibles sur les clichés.
3. L'iléus mécanique présente un aspect radiologique qui change rapidement, par opposition à l'iléus paralytique. Un cliché simple peut souvent rendre de grands services pour le diagnostic différentiel.
4. La soi-disant "Sentinel Loop" de l'iléus paralytique est signalée comme un autre signe utile de différenciation. L'augmentation de l'amylase sérique aidera souvent à identifier le pancréas comme source d'infection.
5. Les données cliniques doivent toujours être considérées de pair avec les données radiologiques. Les cas rapportés sont caractéristiques.

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FISTULA GASTRODUODENALE (BULBAR): *

Report of two Cases

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Spontaneous gastro-duodenostomy is relatively uncommon. Two cases, one due to an ulcerating carcinoma of the stomach, the other to a perforating non-malignant ulcer of the lesser gastric curvature are presented because of their clinical and radiological interest.

Case I. A white female, aged 54, was admitted to Evangelismus Hospital, Athens, September 6th, 1945, complaining of listlessness, loss of appetite, indigestion and epigastric discomfort after eating, for the preceding six months. These symptoms had increased during the last two months, accompanied by vomiting with increasing frequency but resulting in relief of the epigastric discomfort. The patient had lost 12 kgms. weight in the six-month period.

Fig. 1.— Case 1. Female, aged 54 years. September 9th, 1945. Extensive ulceration of lesser curvature with neoplastic margin. Note pointed penetrating base of ulcer. Heaped-up carcinomatous margin.

Roentgen examination on September 9th, 1945, revealed an extensive ulcerating carcinoma of the lesser curvature, from the crater of which a pointed addition defect extended superiorly (Fig. 1). With further examination and bi-manual palpation, the barium meal was caused to pass through the apparently spastic and slightly constricted pylorus to demonstrate a fairly normal duodenal bulb.

In spite of the general condition of the patient, surgery was advised, but was refused by the patient who then returned home.

Fig. 2.— Case 1. Re-admission March 14th, 1946, about two months after sudden relief of obstructive signs. Fistula between previous penetrating ulceration in the carcinoma and the duodenal bulb. Pre-pylorus constricted and pylorus stenosed by encircling carcinoma.

Her symptoms gradually increased with further loss of weight until three days after Christmas of 1945, when the vomiting stopped spontaneously and she could eat easily. Weakness and epigastric discomfort continued, but her general condition improved during January and February, 1946, with a gain of 5 kgms. in weight.

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* Presented as a scientific exhibit, 6th International Congress of Radiology, London (England), July, 1950.

** U.N.E.S.C.O. Fellow, McGill University, Royal Victoria Hospital and Montreal General Hospital, Montreal, Canada, 1950.

Early in March the epigastric pain increased, the general condition deteriorated sharply, and she was readmitted to the hospital on March 14th.

Under the fluoroscope, the barium meal was observed to flow down the lesser curvature of the stomach directly through the carcinomatous crater into the duodenal bulb (Fig. 2). The entire prepylorus was filled and constricted and no barium could be persuaded by any manipulation to pass through the pyloric canal. At the earlier examination (6 months previously) appreciable food residue had been encountered, but at the second examination no retained fluid or food was encountered.

At autopsy, following the patient's death on August 2nd, 1946, the carcinomatous crater on the lesser gastric curvature measured 3 cm. in diameter. The edges were markedly elevated and rounded, and contained yellow flecks of necrosis. The base of the crater communicated directly with the duodenal cap through a fistula, about 4.5 cm. long and large enough to permit a pencil to be passed. The fistula seemed to lie along the plane of the lesser omentum and the gastro- and hepato-duodenal ligaments, the whole being encased by a carcinomatous mass of tissue filling the space between the stomach, the upper duodenal region and the inferior surface of the liver. The prepyloric portion of the stomach and the pylorus were markedly infiltrated and thickened with dense sclerotic tissue, effecting a complete stenosis of the pyloric canal. Diffuse carcinomatous metastases were found in the liver and in all the regional nodes.

Comment: The spontaneous relief of the obstructive gastric symptoms, especially the vomiting, and the temporary subsequent improvement in weight may be presumed to have been the result of the establishment of the fistula between the stomach and the duodenum through the ulcerating carcinoma. This would indicate that the fistula established a spontaneous gastro-duodenostomy at Christmas time, 1945.

Case II. A white farmer, aged 48 years, was admitted to Evangelismus Hospital on May 1st, 1944, complaining of periodic epigastric pain, not related to meals nor relieved by food or alkalis, over the previous two years.

Roentgen examination on May 4th, 1944, revealed a huge ulcer crater on the lesser curvature of the stomach near the ungulus with a marked spastic incisura on the greater curvature, opposite the crater. The distal portion of the stomach appeared as a pseudo-pouch. The pyloro-duodenal junction was displaced upwards and towards the left. (Fig. 3).

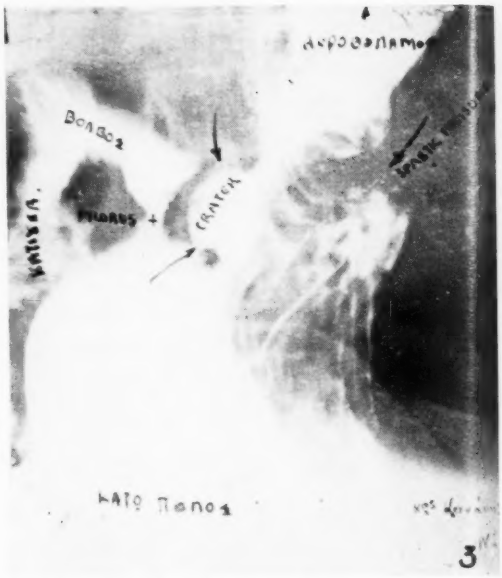

Fig. 3.— Case 2. Male, aged 48 years. May 4th, 1944. Huge ulcer crater on lesser curvature with spastic contracture of greater curvature locally. Pyloro-duodenal junction and bulb pulled upward and toward ulcer area.

In this patient, also, surgery was advised but refused, and he was discharged from the Hospital.

In spite of a dietetic and medical regimen, the symptoms increased until almost a year later, in April, 1945, when after a severe attack of pain lasting a few days, they spontaneously decreased. During this attack, the patient was admitted to the Hospital for five days, but refused to submit to radiological examination.

For the subsequent two years the patient had slight epigastric discomfort and slight pain at variable intervals of months.

Roentgen examination as an out-patient on September 9th, 1947, revealed that the duodenal cap was fixed to, and directly connected with, the ulcer crater on the lesser curvature and that barium passed directly from the stomach into the duodenum (Fig. 4). The former spastic contracture of the stomach opposite the ulcer and the pseudo-pouch of the distal segment of the stomach were no longer apparent. The remainder of the duodenum was normal. Detail spot-films with compression over the gastro-duodenal fistulous area showed a typical corona of the gastric muscosa leading directly into the duodenal bulb at the site of the former ulcer.

Fig. 4.— Case 2. September 9th, 1947, 2½ years after sudden exacerbation of pain followed by relief of symptoms. Fistula established between ulcer and duodenum with disappearance of local spasm. Presumably benign.

The patient felt sufficiently well that he again refused to have any surgical intervention.

Comment: In this case, the obvious time when the fistulous connection was accomplished must have been in April, 1945, at the time of the severe attack of epigastric pain. It may be assumed that with the establishment of the stoma between the ulcer crater and the duodenal bulb, the local inflammation about the perforating ulcer subsided, and a certain amount of healing ensued, as indicated by the pattern of the mucosa on the later radiological study.

In summary, these two cases demonstrate clinically and radiologically the progression of ulcerating lesions of the distal portion of the stomach, predominantly involving the lesser curvature, one proven malignant, the other presumably benign, with spontaneous production of gastroduodenal fistula. At the time of the culmination of the inflammatory, and to some degree the obstructive features, each patient passed through an episode of extreme discomfort, which rapidly subsided following the apparent establishment of the fistulous by-pass between the stomach and the duodenal bulb.

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7th International Congress of Radiology, 1953

PRELIMINARY NOTICE

In accordance with the decision of the International Committee of Radiology which met in London in July, 1950, the 7th International Congress of Radiology will take place in Copenhagen in 1953. The dates of the Congress will be July 19th - 25th.

The officers for the Congress are as follows:

Honorary President:	Prof. Niels Bohr
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Radiologists from throughout the world will be welcome at the Congress. All national radiological societies are being asked to supply a list of their members, and full details about registration for the Congress will be sent to all radiologists individually as soon as they are available.

Correspondence should be addressed to the Congress Office at 10 Oster Voldgade, Copenhagen K.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Textbook of Radiology (German), 4 volumes, by von H. R. Schinz, W. E. Baensch, E. Friedl and E. Uehlinger. Georg Thieme, Liepzig, Germany.

Roentgen Manifestations of Pancreatic Disease, by Maxwell Herbert Joppel. Charles Thomas, Springfield, Illinois.

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The plates have been brought up to date and greatly augmented, the text has been revised and enlarged to include recent advances in the field. Written and edited by men who have made a place for themselves in roentgenology, here is an outstanding contribution to the literature.

The volumes provide the specialist with a detailed survey that stresses roentgenology as an essential part of the entire field of medicine and surgery. Because the authors take this broad view, ROENTGEN-DIAGNOSTICS is also an ideal workbook for the physician who does not specialize in roentgenology yet needs a fuller understanding of its diagnostic applications to his own medical or surgical problems.

The four volumes following publication of Volume I are in preparation now and will be available in six-month intervals. The entire project is planned to be completed in 1953.

The price of Volume I is $36.00; orders will be taken on a subscription basis for the complete set.

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Annual Meeting - January 1952 - Winnipeg

The first mid-winter *annual* meeting of the Canadian Association of Radiologists will be held in the McDonald Room of the Fort Garry Hotel, Winnipeg, on January 16th, 17th and 18th, 1952.

Sessions are scheduled as follows:

Meeting of Executive:	9:00 A.M., Wednesday, January 16th.
Meeting of Council:	2:00 P.M., Wednesday, January 16th.
Scientific Session and Commercial Exhibits:	All day Thursday, January 17th.
Annual Dinner and Annual General Meeting:	6:30 P.M., Thursday, January 17th.
Scientific Session and Commercial Exhibits:	All day Friday, January 18th.

TENTATIVE PROGRAM

Scientific Sessions

The major item will be *a symposium on Co^{60} beam therapy*, which will include the following phases:

— "Considerations in the Design of Co^{60} Beam Therapy Equipment" — R. F. Errington, Ottawa.

— "Physical Characteristics of the Radiation in Co^{60} Beam Therapy" — D. H. E. Johns, Saskatoon.

— "Protection against the Direct and Scattered Radiation of Co^{60} Beam Therapy Units" — Dr. A. Morrison, Ottawa.

— "Disadvantages and Advantages of Co^{60} Teletherapy" — Dr. I. H. Smith, London, Ontario.

— "Clinical Possibilities of the Cobalt Beam unit" — Dr. T. A. Watson, Saskatoon.

Mr. William C. Stronach of the American College of Radiology will be guest speaker at the annual dinner.

Confirmed titles on the program will include:

— Dr. E. Dale Trout, Milwaukee — "The Patient Dose in Diagnostic Radiology and Methods for Controlling it".

— Dr. E. M. Crawford, Montreal — " An Enquiry into the Effects of Radiation upon the Heart from Multiple Fields".

— Dr. W. J. Elliott, Winnipeg—"The Roentgen and Gastroscopic Findings in Gastric Lesions".

— Dr. G. C. Burkell, Saskatoon — "Radiation Leukopenia and Cortisone".

— Dr. Digby Wheeler, Winnipeg — "Internal Fixation of Femoral Neck Fractures — Fluoroscopic Control".

— Dr. E. R. Harrigan, Toronto—"Polyostatic Fibrous Dysplasia".

— Dr. W. H. Thorleifson, Vancouvèr — "Enlargement Technic in Radiography".

— Dr. A. Gibson, Winnipeg — "Tuberculosis of the Greater Trochanter".

— Dr. H. E. Johns and Miss S. O. Fedoruk, Saskatoon—"A Complete Depth Dose Survey over the Energy Range 150 KvP to 23 MeV".

— Dr. A. E. Childe, Winnipeg — "Developmental Thinness of the Parietal Bones".

— Dr. M. K. Kiernan, Winnipeg — "Intramural, Extramucosal Tumors of the Oesophagus".

— Dr. S. Windle, Winnipeg — "Air Contrast Visualisation of the Stomach".

— Dr. Jean Louis Léger, Montreal — "A propos d'une Nouvelle Substance de Contrase: l'Angiopac (Rapport Préliminaire)."

Hotel accommodation can be obtained by writing to: Dr. W. J. Elliott, 101 Medical Arts Building, Winnipeg, Manitoba.

Counsellors and chairmen of committees are reminded that divisional and committee reports will be required for this mid-winter *annual* meeting, together with a report on the election of counsellors, by the various divisions, for the year 1952.

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